

6.3.1 Handset features matrix

NOTE: some functions and features will require additional network capabilities.

HANDSET FEATURES	BASIC	ENHANCED
Size and Weight	T; AT; PTS Pocket size and less than 10 ounces AC/WB Comparable to existing cordless	T; AT; PTS Smaller and lighter
Battery Type	Standard alkaline or separate rechargeable	Internally rechargeable
Battery life (rechargeable)	T; AT; PTS 18 hours standby; 2 hours continuous talk AC/WB 18 hours standby; 4 hours continuous talk	T; AT; PTS Longer battery life (e.g., up to 1 week standby; 14 hours continuous talk) AC/WB Longer battery life (e.g., up to 1 week standby; 28 hours continuous talk)
Extended life battery	Available	Available
Battery level indicator	Low battery indicator e.g., audio or visual	Continuous battery strength indicator; combination of indicators (e.g., audio or visual)
Service indicator (6.3.3.1.4.1)	in-range	Signal strength, with possible alert when leaving coverage area
Service provider indicator and selection (6.3.3.1.4.5)	Home/roam	Specific carrier
Dialing ((6.3.3.1.1)	Standard numeric DTMF as available with a conventional wired telephone (no send button); positive dialing feedback (e.g., tone)	Advanced (e.g., alphanumeric and voice recognition); positive dialing feedback (e.g., tone and display)

Ringer control (6.3.3.1.4.7)	T; AT; PTS Standard ringer AC/WB Multiple types (e.g., multiple tones, vibrate, and/or flash) and volume control	T; AT; PTS Multiple types (e.g., multiple tones, vibrate, and/or flash) and volume control
Display (6.3.3.1.6) (6.3.3.2.1)	T; AT; PTS Numeric AC/WB Fully addressable alphanumeric; scrolling	T; AT; PTS Fully addressable alphanumeric; scrolling
Volume control (6.3.3.1.3.3)	T; AT; PTS None AC/WB Adjustable; mute	T; AT; PTS Adjustable; mute
Encryption (voice radio link) (6.5.2)	None	Private/public key encryption (e.g., DES)
Keypad illumination	None	Adjustable
Function keys (6.3.3)	T; AT; PTS None AC/WB Multiple function keys; access from scrolling display and menus	T; AT; PTS Multiple function keys; access from scrolling display and menus
Memory Storage	T; AT; PTS None AC/WB Multiple memory locations (e.g., 99)	T; AT; PTS Multiple memory locations (e.g., 99)

Separate data ports	T; AT; PTS None AC/WB Analog and/or digital (e.g., RJ11/RS232)	T; AT; PTS Analog and/or digital (e.g., RJ11/RS232)
Separate paging capabilities	None	Integrated with handset
Smart card interface (6.3.3.2.10)	Optional	Integrated with handset

6.3.2 Additional requirements - The handset must:

6.3.2.1 Generate local (within the handset) signaling such as dialtone, fast and slow busy, etc.

6.3.2.2 Generate positive DTMF (locally generated) feedback through handset receiver.

6.3.2.3 Transmit outdialed digits using logic recognizing the North American Dialing Plan, eliminating the requirement for a traditional "send" button to dial digits in basic operations.

6.3.2.4 Have attractive ergonomics for convenience of use.

NOTE: When batteries are changed the handset should retain its existing parameters.

6.3.3 Functionality: Defines the characteristics of the handset with respect to messaging. It includes all external interfaces within the handset such as external devices, audible annunciators, visual indicators, and user interaction devices.

6.3.3.1 Basic and Enhanced

6.3.3.1.1 Digit Entry Keys: The handset shall have a key pad with keys numbered and lettered as a standard landline telephone instrument, including * and #. In addition to inputting digits, these keys will allow data entry and menu editing. The keys will be of adequate size and spread for easy dialing.

DTMF: Allows the subscriber to send DTMF digits after call set-up. The DTMF digits will be sent as the subscriber presses the digit keys. Whenever DTMF digits are sent, the subscriber should hear a locally generated feedback tone (not necessarily the actual DTMF tone).

6.3.3.1.2 Function Keys: Basic handset functionality may require no function keys or separate function keys; enhanced handset functionality would allow standard digit entry keys to be used in conjunction with a menu presented on the enhanced handset display. This enhanced functionality may be a minimum requirement for WB.

6.3.3.1.2.1 Clear: clears data entered into the data fields on the display

6.3.3.1.2.2 Store: Access to the routines for number storage in the directory

6.3.3.1.2.3 Recall: access to the directory redial procedures

6.3.3.1.2.4 Menu/Select: enters menu mode and once in mode selects menu options

6.3.3.1.2.5 Help: Allows subscriber access to on-line assistance in utilizing handset or network features.

6.3.3.1.3 Switches: May be implemented as a physical switch - either external or internal, a mode changed by a key sequence local to the handset, or a one time local function code.

6.3.3.1.3.1 Switchhook (Flash): The switchhook allows the subscriber to end a call or connection and can be used to generate a flash request or switchhook flash. Switchhook could also function as the termination key to end display editing.

6.3.3.1.3.2 Hold: Allows the subscriber to interrupt communication on an existing call and then subsequently, if

desired, reestablish communication.

6.3.3.1.3.3 Volume Control (VC):

Controls the ringer and receiver volume. Basic-none; enhanced-continuously adjustable with mute. VC can also be used for other functions (e.g., to scroll menu functions on the display).

6.3.3.1.3.4 Mode: Allows the handset to switch from one mode to another (e.g., different frequencies, modulation techniques, spreading rates, public to private, etc.)

6.3.3.1.4 Indicators/Annunciators: Used to visually or audibly display a particular condition or the occurrence of an event needing immediate attention to the user. An indicator/annunciator may be implemented as an external light, a text message, a ringer, or however a manufacturer chooses.

6.3.3.1.4.1 In Use: Indicates when a connection is established with a base station.

6.3.3.1.4.2 Service : Basic-indicates in range; enhanced-indicates signal strength with possible alert when leaving coverage area.

6.3.3.1.4.3 No Service: Indicates a handset does not have contact with a base station with which it can register.

6.3.3.1.4.4 Service Provider: Basic-indicates home/roam; enhanced-indicates specific service provider.

6.3.3.1.4.5 Battery Level: Basic-indicates low battery; enhanced-indicates continuous battery strength.

6.3.3.1.4.6 Message Waiting: Indicates a voice message waiting (e.g., tone, visual, etc.).

6.3.3.1.4.7 Call Alerting (Ringer): Basic-standard ringer; enhanced-multiple pitches and cadences for different call types (e.g., tones, vibrate, flash, etc.).

6.3.3.1.4.8 Call Forwarding Reminder Alert: Signals that the subscriber's personal number is forwarded to another number. This alert is applied one time by the handset for each network invocation.

6.3.3.1.4.9 Message Waiting Alert: Informs the user of an unretrieved message in the network voice mail system.

6.3.3.1.4.10 Call Waiting Tone: Informs the user of an incoming call while the user is already engaged on a previous call.

6.3.3.1.4.11 Radio Contact: An indication to show that radio contact is established.

6.3.3.1.4.12 Key Feedback Tones: An audible indication when a key is pressed.

6.3.3.1.5 Call Progress Tones: Handset will have the capability to generate certain call progress tones to inform the user about the progress of the call. The sidetones should be heard over the normal voice speech path.

6.3.3.1.5.1 Reorder Tone (busy): A tone locally generated upon command of the base station or upon losing radio contact. The reorder tone shall use the same cadence although the tone used may be distinctive from the network generated reorder tone.

NOTE: This Call Progress Tone list is not conclusive and will be the subject to further study.

6.3.3.1.6 Numeric Display: The Basic handset functionality will have a numeric display to allow the user to review entered or delivered digits.

6.3.3.1.7 Outgoing Call Barring: Allows a user to block or allow specified outgoing calls based on the dialed number. In order to avoid accessing the network for which

charges might be incurred, this feature should be implemented at the handset.

6.3.3.2 Enhanced handset features

NOTE: These enhanced features may be required to support Wireless Business handset applications for full business functionality.

6.3.3.2.1 Alphanumeric Display: The handset will provide a display for alphanumeric messages to indicate call progress, caller identification, or other interactive services.

6.3.3.2.2 Last Number Redial: The handset may, with a few key strokes, be capable of dialing the last number(s) dialed by the handset.

6.3.3.2.3 Speed Dialing: Capability of dialing a telephone number with a few key strokes.

6.3.3.2.4 Repeat Dialing: Continues to dial a busy number and alerts the subscriber when the dialed number is no longer busy. The subscriber can then complete the call.

6.3.3.2.5 Hands Free Operation: Provides for the user the ability to operate the handset remotely in a number of environments such as mounting in a vehicle or in stationary (e.g., desk top) applications. The handset could have an aperture for a remote loud speaker and microphone as well as for earphones and microphone headsets.

6.3.3.2.6 External Line Interface: The handset and wireless terminal adaptor may provide an external line connection supporting a standard loop start line interface to allow direct connection of telephone devices such as data modems, fax machines, answering machines, etc.

6.3.3.2.7 Hearing Aid Compatible: Requires that the earpiece element of the handset provide inductive coupling with a hearing aid. Since this feature has a major impact on battery life, this should be a custom, optional feature, only implemented at the request of a user.

6.3.3.2.8 Macro Key Sequence Generation:

Allows experienced users easy access to some of the more comprehensive handset features by allocating short keys to a longer key sequence in order to simplify their use.

6.3.3.2.9 Control PIN: A secondary PIN utilized over and above the primary PIN as a security PIN for establishing calling profiles. The Control PIN can be used to limit call types in cases such as distribution of smart cards to employees or children.

6.3.3.2.10 Smart Card Interface: A standard interface in a handset or wireless terminal device that provides for the insertion and reading of a removable Subscriber Identity Module (SIM) called a smart card.

NOTE: Subscriber information as well as subscribed to capabilities should be contained on a SIM. The SIM could be external and removable as in a smart card. The object of the smart card is to dissociate the handset and its features from the unique aspects associated with the subscriber or user's identity and status.

6.4 Authentication and Validation (A & V) - (Mandatory)

6.4.1 Provides authentication (identification) of the subscriber for billing and accounting purposes.

6.4.2 Provides validation of the wireless device and the user to ensure the viability of both the user and the device being used. This process can be combined, as in the minimum handset requirement, or separately, as required in the enhanced handset or terminal device.

6.4.3 Both A & V should involve the Personal Number (PN), Subscriber Identification Module (SIM), the subscriber supplied Personal Identification Number (PIN) and the Electronic Serial Number (ESN) of the device.

NOTE: The ESN of a wireless device should also contain standardized information as to the capabilities of the device. This information, transmitted to the network, would assure that compatible formats and protocols would be delivered to the device (e.g., data would not be sent to a voice only handset).

6.5 Security (Mandatory)

6.5.1 Handset: Allows unauthorized use protection by requiring the user to enter his PIN which is then verified against the Subscriber Identity Module (SIM) number. The handset will default to requesting the user for his PIN upon powering up the device. This default can be disabled through the menu.

6.5.2 Enhanced Privacy: Users may feel uncomfortable with wireless devices because of the worry of others intercepting their communications. For example, landline users may feel uncomfortable not knowing whether or not the wireless end link is private. The system should provide the means of enhancing privacy. One possible implementation might be to encrypt all signaling and subscriber information between the personal terminal and base station. Another would be to allow for easy attachment of external encryption equipment.

6.5.3 Fraud prevention: The authentication and validation process should permit the system operator to detect fraudulent wireless devices and /or unauthorized users before service is granted. This prevention should extend to both circuit- and packet-switched data, as well as for speech.

6.6 Reliability: [TO BE SUPPLIED]

7 Requirements for Detailed Service Description Standards for Wireless PCS Handset and Terminal Adaptor

The purpose of this document will be to identify standards for and specify operation and implementation of wireless and uniform features.

This document should be specific as to how each service or feature will be implemented and point out interworkings and interrelationships between services and/or features. These implementations should be standard and uniform across all networks and any variance or deviation should be noted.

The format for this document will be left up to the appropriate standards body and may be revised from time to time.

8 Economic and Cost Considerations

New technology for PCS must be made available to both carriers and end users at reasonable price points. Specific consideration of the elements and issues of the impact of new PCS technology on manufacturers, system operators, and potential PCS customers are set forth below.

8.1 Handset Considerations

Although the PCS handset end user cost will vary according to the features and functionality contained therein, a target range of \$150-300 should be set for the handset used in a PTS application. This end user price range should be obtainable within a reasonable time after start of production (2 - 4 years) and at reasonable customer penetration levels.

8.2 Manufacturer Considerations

Although manufacturers have committed substantial resources to PCS Research and Development, network and personal terminal manufactures have an incentive to maximize their return on investments that have previously been made in developing and deploying existing wireless technologies. Manufacturers are also sensitive to the timing and the magnitude of change caused by the introduction of new technologies. The growth of product demand (network and personal equipment) and pressures to bring unit costs down are contrary to the early availability of new technology. For these reasons, the development of an evolutionary network and personal terminal standard(s) which provides for the introduction of new, more advanced technologies and takes advantage of existing technologies is recommended.

Since one or more manufacturers may possess unique breakthrough technologies, manufacturer willingness to license and share technology under favorable terms and conditions is essential to establishing technologies that will facilitate system interoperating or interworking while minimizing the cost for the entire industry.

8.3 Carrier Considerations

The implementation of new technology at a reasonable cost will impact system operators in several areas.

8.3.1 Capital Recovery

Notwithstanding the manufacturer considerations described in section 8.2, from the carrier's perspective new PCS technologies and network and personal terminal standards should be developed independent of the technologies and standards that are used to provide other wireless services and without regard to recovering capital invested in alternate wireless technologies. However, in recognition of the fact that certain functions might be performed more economically by an existing network, the new PCS technology and network and personal terminal standards should clearly define the various components of the PCS network functionality and provide, where feasible, standard interfaces between those components based to the greatest extent possible on existing network standards.

The number and type of PCS features and services which will be provided is also expected to expand and evolve over time. Therefore, the new PCS technology and network and personal terminal standards must be flexible and provide a means for accommodating long-term expansion and evolution. Such flexibility will allow operators to introduce new advanced technologies and services without jeopardizing the investments that are to be made in deploying initial PCS technologies.

8.3.2 First Cost of New Technology

The first cost of new PCS network technologies should be equivalent to or less than existing wireless technologies. Selection criteria should compare the capital investment required to serve an equivalent number of analog or digital technology customers at expected penetration levels over time.

8.3.3 Investment Efficiencies

As previously described in section 8.3.1, certain functions might be performed more economically by an existing network. As a result, the new PCS technology and network and personal terminal standards should clearly define the various components of the PCS network functionality and provide, where feasible, standard interfaces between those components based to the greatest extent possible on existing network standards. New PCS technology must appear transparent to the other networks to the greatest extent possible.

8.3.4 Operating Costs

The operating cost of the new PCS network technologies should be equivalent to or less than comparable existing wireless technologies. Elements to be considered include transmission maintenance, environmental considerations for cell sites, operational support systems, etc. Selection criteria should compare the operating costs required to serve an equivalent number of analog or digital technology customers at expected penetration levels over time.

8.3.5 PCS Customer Perspective

The success of new PCS technology will depend on customer acceptance. To be successful, new PCS technology must be perceived as being competitive with the value of service provided by existing wired and wireless services. Criteria used to evaluate the competitiveness of the initial price should include both the quality of service and service capabilities.

9 Operations, Administration, and Maintenance (OA&M)

OA&M features support applications associated with the supervision of the wireless system and its component parts.

Wireless OA&M Support Reference Model: TBD

Wireless OA&M standards requirements will be addressed in a forthcoming Telocator SRD.

10 Standardized Interfaces

Telocator expects to issue Standards Requirements Documents dealing with Air Interface and Network Interface standards. This section summarizes the basic principles that will be used in those documents.

10.1 Common Air Interfaces

Although it is recognized that many uncertainties exist about the future PCS markets, regulations and available technologies, there are several customer desired service characteristics that will probably effect the design of a Common Air Interface. These include:

10.1.1 Low cost is very important.

10.1.2 The minimum number of interfaces is desirable. This supports the goal of 10.1.1 above. It also more readily supports the goal of facilitating ubiquitous availability of service, roaming, and follow-me services.

10.1.3 The air interface(s) must support all PCS services as listed in Section 5.

10.1.4 The interface(s) must be able to be implemented at the earliest possible time.

10.1.5 The common air interface(s) must support all the quality and performance requirements specified in Section 6.1.

10.1.6 The interface(s) should be flexible enough to support unique or proprietary enhancements to the basic standard to allow service providers/suppliers the opportunity for differentiation.

It is also recognized that service providers/suppliers may choose to implement different available air interfaces in attempts to differentiate their services. This may be affected by the market structure that is created in the U.S. (i.e., it is likely that there will be more than one PCS license per market area). The possibility that service providers/suppliers may tend to choose different air interfaces could raise issues of concern to both policy makers as well as standards managers.

10.2 Network Interfaces

Without the industry-wide adoption of network interface standards, it is unlikely that the continuum of Personal

Communications Services will be successful. The lack of standards can be problematic for the entire industry.

The concept of a transparent, seamless network is the key to the future of PCS and a set of common network interfaces between multiple switching centers helps ensure the growth and technical innovation of PCS.

10.2.1 PCS must have the following characteristics:

10.2.1.1 Must provide for the interworking of existing and new networks (voice, data, and signaling).

10.2.1.2 Network capability must provide for the exchange of all signaling information.

10.2.1.3 Users (subscribers) must be able to access services subscribed to and contained in their user profile, independent of service provider and geographic location.

10.2.1.4 Common standards to ensure appropriate billing.

10.2.1.5 Common standards to ensure fraud control.

10.2.1.6 Common standards to ensure user control of call management (e.g., routing and blocking).

10.2.2 Therefore standards for the following Functional Network interfaces are being considered: (Figure 1)

10.2.2.1 Data Terminal to Personal Terminal (T-Interface)

10.2.2.2 Personal Terminal to Radio Port (A-Interface)

10.2.2.3 Radio Port to Radio Port Manager (P-Interface)

10.2.2.4 Radio Port Manager to PCS Switching (C-Interface)

10.2.2.5 PCS Switching to External Networks (N-Interface)

10.2.2.6 PCS Switching to Interworking Function (L-Interface)

**10.2.2.7 PCS Switching to Operations Systems
(O-Interface)**

**10.2.2.8 PCS Switching to Mobility and Service
Management (e.g., data bases)
(D-Interface)**

**10.2.2.9 PCS Switching to Auxiliary Services
(e.g., voice mail, external data services, etc.)
(X-Interface)**

**10.2.2.10 PCS Switching to Wired Terminal Devices
(W-Interface)**

Existing standards should be used to fulfill the above needs where applicable.

10.3 Physical Implementation Alternatives

Figure 2, Physical Implementation Alternatives, illustrates four sample combinations of the functional elements into physical packagings. These and other samples will be investigated for inclusion in the forthcoming Network Interface SRD.

The four implementation alternatives are:

10.3.1 All functional elements are physically manipulated into associated physical devices.

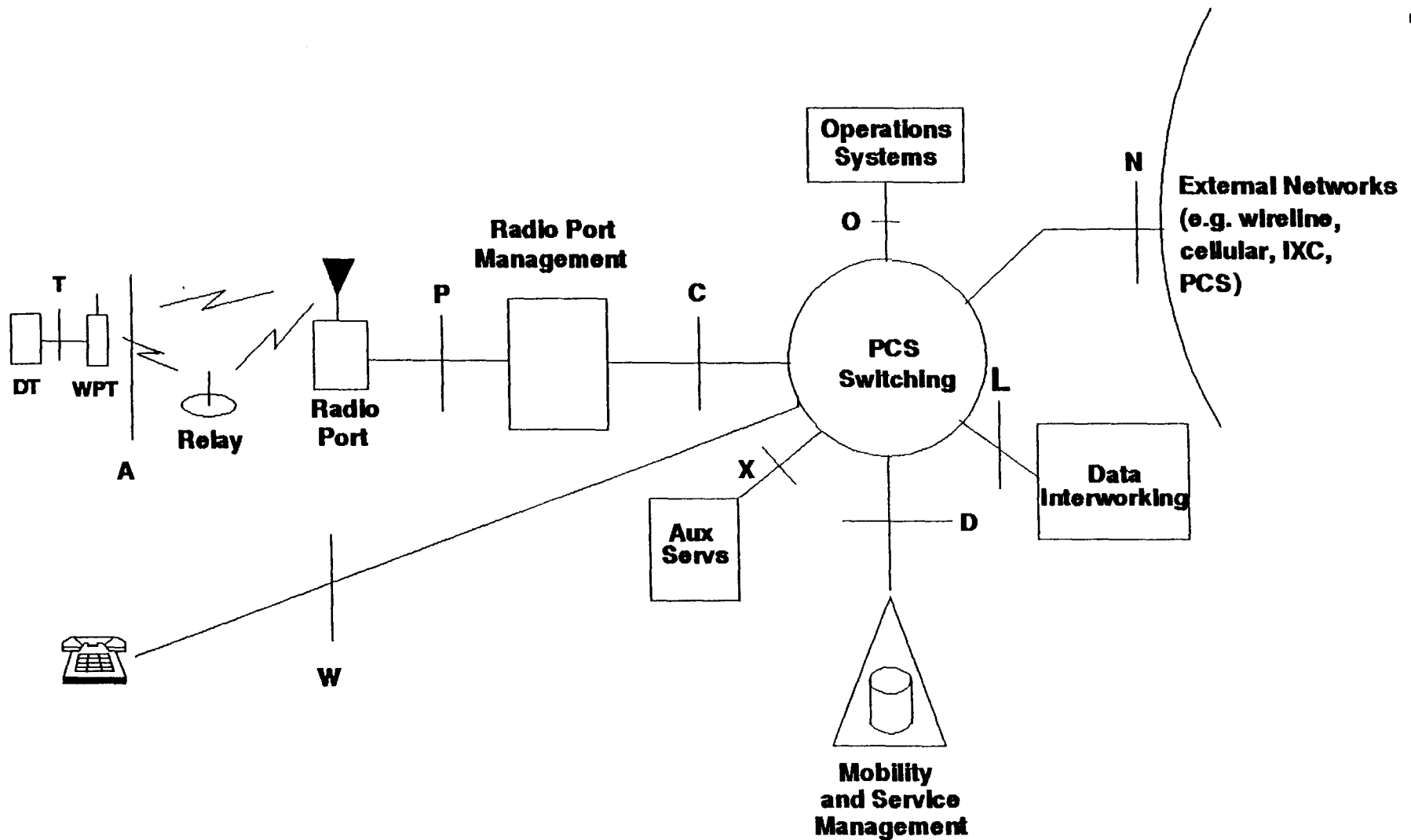
10.3.2 The Radio Port Manager and Radio Port functions are combined into an Intelligent Base Station which internalizes the P-Interface.

10.3.3 The Radio Port Manager and PCS Switching functions are combined into a physical PCS Switch which internalizes the C-Interface.

10.3.4 The Service and Mobility Management function can be implemented in a variety of physical devices such as an SCP, an adjunct, or even as part of a PCS Switch.

Air and Network Interface standards requirements will be addressed in forthcoming Telocator SRDs.

Functional Network Architecture



Telocator T&E Network Subcommittee
July 1992 (Revised)

Figure 1

Attachment 1

PCS Network Architecture Definitions

Interface Definitions

- A- Set of common air interfaces carrying bearer, signaling control, and possibly operations information between wireless portable terminals(WPT) and Radio Ports.
- T- Set of interfaces to facilitate the interconnection of data terminals and wireless portable terminals for the purpose of accessing a PCS network.
- P- Set of interfaces carrying bearer, signaling, control and operations information (and possibly power) between Radio Port Management and Radio Ports.
- C- Set of interfaces carrying bearer, signaling, control and operations information between PCS Switching and Radio Port Management.
- W- Set of interfaces carrying bearer, signaling, control and operations information (and possibly power) between PCS Switching and wired terminal devices.
- S- Set of primarily bearer interfaces to support access to Auxiliary Services (e.g. voice mail).
- D- Set of primarily signaling interfaces to support personal and/or terminal mobility, and service management.
- O- Set of interfaces carrying operational information to support monitoring, testing, administration, traffic and billing requirements.
- L- Set of interfaces between a PCS switching center and a data interworking element.
- N- Family of interfaces which includes S,D & O offered to other networks.

Functional Element Definitions

- Wireless Personal Terminal A tetherless device that provides communications capability via a common air interface.
- Data Terminal A device that generates data transmission and may interface a wireless portable terminal for the purpose of accessing a common air interface.
- Radio Port This element supports the transmission of signals over an air interface. This includes, for example, RF transmit and receive functions, modulation/demodulation and channel coding.
- Radio Port Management This element concentrates traffic from radio ports, manages radio mobility and interference functions, and provides an interface into switching systems.

PCS Switching	This provides switching for voice and data bearer capabilities and for signaling. It encompasses many levels of switching in private and public networks, including for example, PBXs, end offices, tandems, MTSOs and packet switching nodes.
Auxiliary Services	These are services which will likely require close interworking with PCS such as voice mail and attendant services.
Mobility and Service Mgmt	This encompasses the data and processing to support personal and terminal mobility and overall PCS services management.
Operations Systems	These are the systems which monitor, test, administer, and manage traffic and billing information for PCS systems.
Data Interworking	A network element that facilitates compatible communications between data devices.
External Networks	These include existing and future networks such as wireline, cellular, IXC's, and those of other PCS and non-PCS providers.

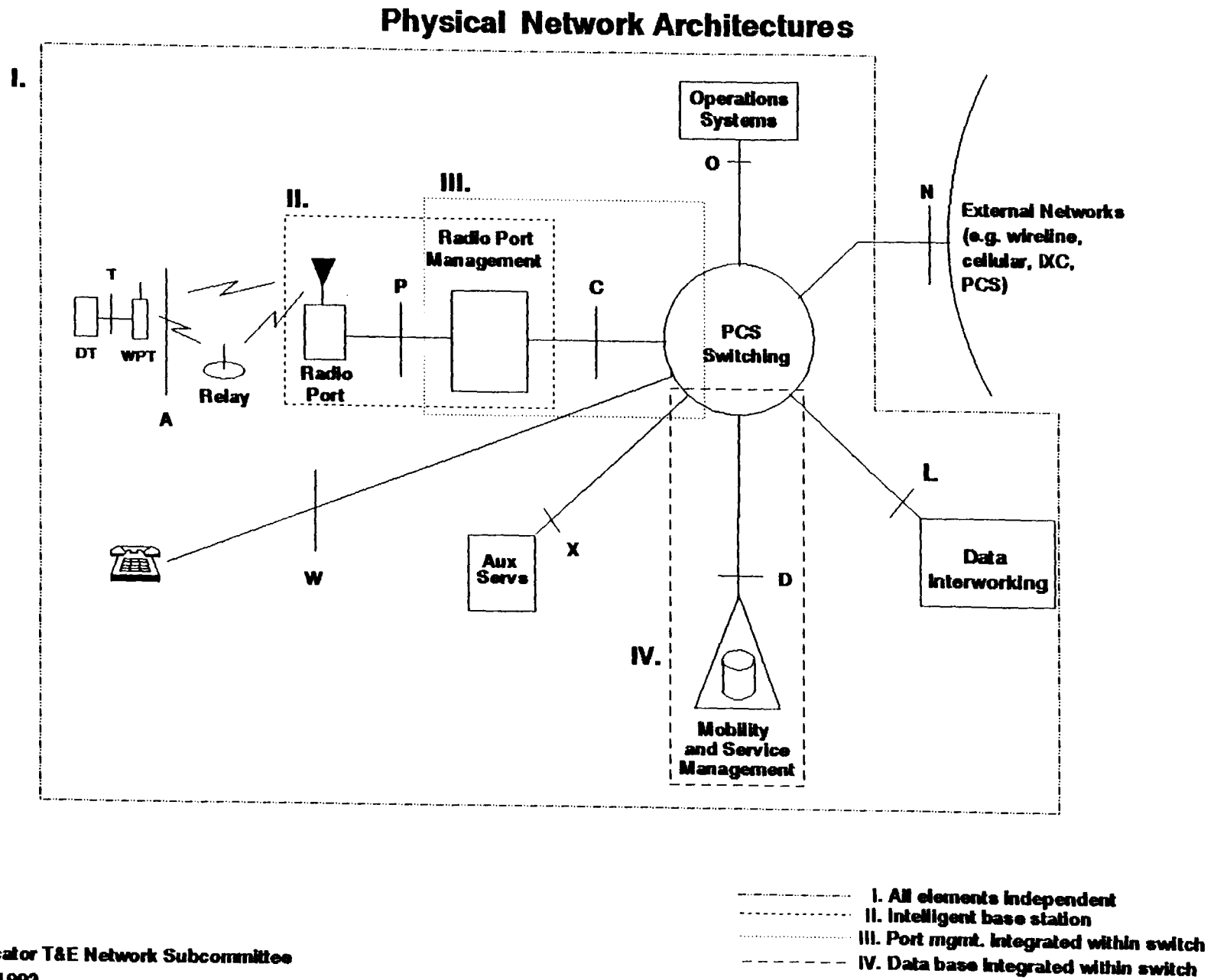


Figure 2

APPENDIX B



TI TR 45

*Report of the Joint Experts' Meeting
on
PCS Air Interface Standards
November 9 - 13, 1992
Reston, Virginia*

Report of the
Joint Experts Meeting
on
Personal Communications
Air Interface Standards

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